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HISTORICAL NARRATIVE (CONTINUED)

The Dispensing and Handling Equipment Division was responsible for developing equipment involved with petroleum-oils-lubricants (POL) dispensing, handling supplies, and aerial delivery of supplies and equipment (Anonymous 1954:Appendix C; USACE, NED 1997:III-36).

The Pioneering Research Division was charged with conducting "long-range research in support of the development programs of the other divisions" (USACE, NED 1997:III-36). The Division comprised Biological, Chemical, Physics and Special Projects branches (Anonymous 1954:Appendix C). Pioneering research, as expected, was involved with the food irradiation program (Quartermaster Research and Development Command 1955; Tressler 1956).

From the outset, research and development activities performed at Natick laboratories were DoD-related in scope (Odell 1954).

> Early tests conducted between February and October 1955 included studies of: a protective, acid and fuel resistant suit to establish tolerance limits when worn in hot environments; the encumbrance effect of arctic clothing to establish techniques for measuring the extent to which arctic clothing interferes with a soldier's ability to use his arms, legs, or body; an energy balance study to establish baseline energy relationships of men prior to their exposure to a desert environment; and a study of several lightweight non-fogging facemask models to measure efficiency in protecting the face without causing frostbite at edge areas. These types of studies, designed to determine testing measurement techniques and to study various aspects of the interrelationship between human physiology, the properties of different materials and products, and a wide range of hot and cold climatic conditions, have been the focus of research and development at the Climatic Chambers since the facility's construction. Nearly all personal equipment used by Army and other military soldiers and many materials and items found in the civilian market have been tested at Natick. In addition, the responsibility to provide specifications for items of Army supply has meant that testing results have affected private industrial production geared to meet military demands [Fitch 1991:13].
>
> Development of boots for adoption by DoD for all military services; [with] field testing conducted by Quartermaster Corps and Army Surgeon General's Office as "part of an Army program to develop and standardize a common inter-service footgear. The Army was assigned the program by the Defense Department under the new single-management concept for all military service supplies" (The Quartermaster Review 1958:62).

Other innovative research conducted at Natick included work on the food irradiation program, which used ionizing radiation from cobalt-60 to preserve stored grain and other products, such as bacon and poultry. Called "radiation sterilization" at the time, food irradiation studies were initiated as part of the "Atoms for Peace" program announced in 1953. Overall responsibility for irradiation studies resided with the Quartermaster Food and Container Institute for the Armed Forces, Chicago. Research at Natick was conducted by the Pioneering

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Research Division, beginning in 1955, and would continue into the 1970s after the Food and Container Institute was co-located to the Natick facility in 1963. An important element of the program was to preserve foods' nutritive content, flavor, texture and appearance, as well as restoring the natural flavor to dehydrated foods. Early studies by the Pioneering Research Division focused on the identification and determination of undesirable odors and flavors resulting from irradiation and dosimetry methods. Food irradiation technology would be transferred to the U.S. Department of Agriculture in the 1980s as well as disseminated to the private sector for commercial uses (The Quartermaster Review 1955:100, 1956c: 47; McGuckian 1955:141; Tressler 1956:5-7; Quartermaster Research and Development Command 1955:11; Calloway 1956:10-11, 19; Gardner 1958:27-28; NRDEC 1994:12-13). Building 16 was identified as the Radiation Laboratory (NARADCOM 1977:111) (Figure 17).

Another element of the research program was protecting the soldier from environmental stresses and elements. The Environmental Protection Division conducted basic and applied research to determine not only the environmental stresses that affected the soldier but the soldier's reaction to them as well. The program also explored a soldier's needs (e.g., food, clothing, supplies, equipment) in order to promote "his personal protection, comfort and maximal operating effectiveness under all climatic conditions in any geographic area of the world" (The Quartermaster Review 1957a: 24). On-going research included extensive tests conducted in the Climatic Chambers at the Quartermaster Research and Engineering Command where:

> all factors of the environment can be completely controlled. As a result, scientific relationships of nutrition to climatic stresses are under study and the basic principles are being applied to the development of suitable rations for our armed forces" (The Quartermaster Review 1957b: 13).

Other accomplishments included determination of rations in climatic extremes in relation to food container storage; coatings for mildew resistant boxes; environmental protection; ration and water requirements determination; and experiments in conjunction with the Ordnance, Chemical and Medical Corps to combine needed protection into one clothing system.

The Quartermaster Research and Engineering Center (QMREC) continued its work for other services throughout the 1950s and 1960s, effecting a DoD-wide impact. The command provided support to Army Aviators through the development of numerous survival kits pertinent to specific missions. Types of survival kits include overwater, cold climate and temperate climate. These kits were comprised of a first aid kit, water bag, compass, hand-generated flashlight, jack knife, flares, subsistence components, and rations. The overwater kit had the added item of a one-man life raft. In addition, the QMREC developed a protective helmet for Navy fliers and was working to develop a helmet that was fragmentation protective (Aldridge 1959:24, 27).

Extensive work was conducted on air-delivery systems (by both rotary and fixed-wing aircraft) to supply ground support for isolated troops. In conjunction with the development of the Pentomic concept, this work included the creation of collapsible containers for bulk storage of petroleum, oils, and lubricants (POL) as well as water. Natick engineers experimented with designs for all types of aids for cargo handling, especially aircraft

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loading and unloading, which included forklifts, conveyors, pallets, and gantries, as well as quick-release harnesses, tie-downs, clamps, and clips (Aldridge 1959:27).

Always focusing on protective needs, the command at SSC Natick knew even in the early 1960s that:

> "Today's combat soldier must be protected from an ever mounting number of battlefield and environmental hazards. While ballistic protection and protection from adverse weather conditions are outstanding requirements, there are many more that must be fulfilled to enable the soldier to function at peak efficiency. To do this, he must be furnished with the means to protect himself against chemical, biological, and radiological warfare, the flash, dazzle and high-intensity thermal energy of nuclear weapons, and such environmental factors as rainfall, snow, ground moisture, blowing sand and dust, and extreme high and low temperatures" (The Quartermaster Review 1961:62).

U.S. Army Radiation Laboratory operational responsibility transferred to the QMREC from the U.S. Atomic Energy Commission on 5 November 1962 (Natick Laboratories 1963:1, 26). Moreover, the relocation of the Food and Container Institute to Natick in August 1963, followed by the removal of the Navy Clothing and Textile Research unit to Natick from Bayonne, New Jersey in July 1967, reinforced the DoD emphasis on the mission and scope of activities at the Natick laboratories (see Josephson 1959:10). "Ensuing requirements were to develop food, packaging and food service equipment for all services and to provide support to the Navy in its textile research" (NRDEC 1994:16).

1960s Development

The installation's physical plant grew during the late 1950s and into the 1960s as the scope of Natick's mission expanded. Major construction projects completed by the end of the decade included the Solar Furnace in 1958; Building 36 (Engineering Building) in 1964 for food processing and container testing (Figure 18); Building 30 (Subsistence Evaluation Laboratory) in 1965; and Building 42 (Environmental Medicine) in 1968 for the Army Research Institute of Environmental Medicine (ARIEM) (Figure 19).

The Environmental Protection Laboratory of the QMC was united with the Office of the Surgeon General's Environmental Research Facilities in 1961 to form the Army Research Institute of Environmental Medicine (ARIEM). Under the direction of the Surgeon General, ARIEM's work embodies activities formerly conducted at Climatic Research Laboratory (in Lawrence, Massachusetts), the Armored Medical Research Laboratory (Fort Knox, Kentucky); and the Earth Sciences Division and Environmental Protection Laboratory (both at Natick). ARIEM investigates how the performance, effectiveness, and health of soldiers are affected by nutrition, occupational stresses (i.e., combat, physical training, work duration) and environmental conditions (i.e., high terrestrial altitude, heat, cold, contamination) (NRDEC 1994:17; USARIEM 2001; USAMRMC 1998:2-1). "The research efforts at USARIEM are geared toward the development of protective and therapeutic material

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and doctrinal solutions to maximize the health and performance of individual military personnel in a variety of environmental climates" (USAMRMC 1998:ii). Located in Building 42, the Institute has an information sharing relationship with the SSC since its research compliments the SSC's efforts to develop equipment, rations, and clothing (NRDEC 1994; USACE, NED 1997:III-36).

Completed in 1968, Building 42 (Environmental Medicine) was designed by Hoyle, Doran and Berry of Boston and was constructed by the Sovereign Construction Company, New Jersey (Natick Laboratories 1965:3). It houses 13 chambers that simulate a variety of environmental conditions at sea level as well as two high altitude climatic chambers (Buchanan and Johnson 1984:25; USACE, NED 1997:35).

Space

As expected, the expertise of Natick scientists in food technology, feeding systems, and protective clothing for both the Air Force and Army would be placed in the service of the U.S. space program. Building on QMC expertise in freeze-dried food for soldiers, scientists and engineers at the Natick installation assisted in the development of foods and packaging for the Mercury, Gemini, Apollo, and Skylab space projects (NRDEC 1994:24-25; USACE, NED 1997:III-36; Gallant 1992). Of the 216 different food components included in the 25 U.S. space flights launched since Project Mercury, 102 were developed at Natick (NRDEC 1994:25).

Other advances and materiel developments in the 1960s concerned the immediate needs of the combat soldier fighting in Vietnam. Efforts focused on supplying troops in the field and improving and diversifying the range of rations available. These improvements included Meal, Combat Individual (MCI) (C-ration created in 1958); a reinforced boot to protect soldiers from contaminated spikes; Quarpel (Quartermaster-developed water repellant finish/treatment) for raingear; sturdy food packaging; quick-drying and disposable, water-proof socks; improved parachutes for airdrop systems, field showers; and a machine for photo composition of ideographic text to prepare leaflets for Special Warfare operations (Natick Laboratories 1970:4-5; NRDEC 1994:18).

By the mid-1960s, Natick scientists were experimenting with food irradiation, body armor for combat pilots and gunners' legs and torso, container design criteria, and controlled descent parachutes (NRDEC 1994:18). Other 1960s advances included improvements in the Lightweight Portable Refrigerator, development of a synthetic fur to replace more expensive wolverine fur, "a protective suit effective against chemical, biological and radiological fallout, a ventilated undergarment to cool aircrews flying in the tropics, and designed containers to better protect air cargoes from in-flight damage" (NRDEC 1994:19).

In terms of clothing, the QMREC sought to develop textiles and functional finishes that could create clothing systems which were protective in chemical, biological and radiological warfare environments as well as providing effective camouflage and comfort without increasing weight or stress on the soldier (Kennedy 1962:149).

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After the Food and Container Institute (Building 16) relocated to Natick in 1963, the food technicians continued to research, field test, and standardize the Army's food recipes. In 1967, the DoD expanded the scope of Natick's recipe development service to encompass all military branches. The first Armed Forces Recipe Service collection of recipes was published in 1969 (Prell 1998).

As expected, supplying troops in combat situations led to improved air delivery systems. For instance, during the Vietnam War, a high altitude airdrop system that could deliver equipment and supplies from 10,000 feet was developed (NRDEC 1994:19). In addition, "[a] quick-release buckle was designed for the load-carrying equipment and body armor, while technicians sought to improve the performance of paper honeycomb as an energy dissipater for airdropped cargoes hitting the ground. Research programs produced a rapid technique for assessing the microbial quality of food, a camouflage overcoloring compound, and civilian clothing offering ballistic protection for police and State Department use" (NRDEC 1994:20).

1970s Development

At the outset of the 1970s, Natick Laboratories consisted of six separate, yet complementary laboratories. These laboratories were engaged in both short-term and long-term research in order to develop products to sustain and protect the individual soldier. The goal of product development was to increase service life of the item, lessen its weight, and decrease its size without reducing its protective quality and effectiveness.

At the beginning of the decade, the six laboratories at Natick were the Clothing and Personal Life Support Equipment (C&PLSE) Laboratory; the Food Laboratory; the Airdrop Engineering Laboratory; the Earth Sciences Laboratory; the General Equipment and Packaging Laboratory; and the Pioneering Research Laboratory (Natick Laboratories 1970:2). The Food Laboratory was reassigned to Fort Belvoir in 1971.

The C&PLSE Laboratory was responsible for developing the soldier's clothing and most of his personal equipment, including body armor, protective equipment, camouflage (e.g., clothing and face creams), and load-carrying equipment. Improvements in equipment included efforts to enhance crash and ballistic protective helmets, cold-weather clothing and equipment (including lightweight clothing and electrically heated handwear), anti-personnel mine-resistant footwear, lightweight yet durable footwear, and a variety of uniforms and body armor, as well as packs, harnesses, ammunition carrying cases, and field equipment (Natick Laboratories 1970:6). Improvements in sleeping gear included the creation of a treatment for waterfowl feathers (Tan-O-Quil) that reduced allergenic characteristics. This treatment was eventually adopted by private industry for treating down pillows and bedding (Natick Laboratories 1970:5). The Food Laboratory was responsible for developing rations and "feeding systems" using dehydrated and freeze-dried foods as well as concentrated foods that were eaten dry (Natick Laboratories 1970:8). The Earth Sciences Laboratory collected and prepared geographical and climatological data to ensure that materiel development dovetailed with the environment for which it was intended (Natick Laboratories 1970:11). The Earth Sciences Laboratory was transferred to Fort Belvoir in May 1971.

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The General Equipment and Packaging Laboratory conducted research, development and engineering tasks on a variety of field shelters, containers, organizational equipment and related products in order to standardize their production within the supply system (Natick Laboratories 1970:13, 1974:22). Many of the activities of this laboratory had broader DoD implications as improved food service systems and equipment created by the Food Systems Equipment Division (e.g., ovens and automatic dishwashers, small cooking stoves and field kitchens, bakery and refrigeration equipment) were applied to garrison, shipboard, aircraft, and field activities of all military branches (Natick Laboratories 1970:13; NRDEC 1994:15-16). For example, the laboratory created the Subsistence Preparation by Electronic Energy Diffusion (SPEED), an all-electric, self-contained, mobile field kitchen. They also designed single trailer mobile laundry and shower bath units, flexible packages that replaced the metal can, air-supported tent structures and expandable, highly mobile shelters (Natick Laboratories 1970:13-14).

In general, the Pioneering Research Laboratory conducted long-range basic and applied research in the physical, life, and behavioral sciences to facilitate commodity development (Natick Laboratories 1970:15, 1974:22). Topics under investigation included food flavor chemistry as well as flavor and taste potentiation. This laboratory studied the effects of laser radiation on the eye, the factors causing flash blindness, and the problems inherent in long term food and equipment storage (subject to contamination by microbes, insects and rodents). One group researched "the damage caused by microbes to cotton cloth, sand bags, plastics, foams, detergents and gasoline. The second group, doing applied work, dealt with the damage caused by insects and rodents to supplies. The group evaluated chemicals used for mothproofing as well as insect and rodent repellents. It developed coating materials for flour sacks that are durable and insect resistant" (Natick Laboratories 1970:16). It was here also that mycologists maintained the National Index of Fungus Culture.

Towards the end of the decade Kevlar came into use for protective vests and helmets. Kevlar is an aramid fiber (linear aromatic polymeric materials) invented by DuPont. Natick tested the product in the early 1970s and introduced it into body armor soon after (TROSCOM 1984:36-37). The continued development of Kevlar-based materials at Natick led to the creation of the Personnel Armor System for Ground Troops (PASGT), which included a torso vest and helmet. Natick also contained the Executive Manager of the AMC Personnel Armor System Technical Plan. Advances in personal protection led to the development of Inconspicuous Body Armor for the Department of Justice, as well as police and other law enforcement personnel. "The protective garments developed to date, which incorporate a Kevlar cloth ballistic filler, includes several types of undershirts, a sports jacket, a dress, raincoat, a uniform jacket, a police reefer coat, a raid jacket, a leather motorcycle jacket, and an outer vest. Generally, these items are designed to protect the wearer against the threat of .38 caliber and less caliber handguns" [NARADCOM 1975 or 1977:66).

Cellulose/Glucose conversion, another early study, also became a significant technical contribution of the new Quartermaster Laboratories. Trichoderma viride, a fungus that feeds by converting cotton to sugar, was responsible for destroying tents and cotton web gear in New Guinea during World War I. Natick scientists discovered how to apply this process to waste cellulose in order to create a usable sugar product, which could then be distilled into methanol for use as a clean burning fuel. The cellulose glucose hydrolysis process was

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later improved by irradiating the fungus, which sped up the conversion process. For its creation of the mutant (irradiated) fungus, Natick received the first ever patent for a life form. "The Army transferred this technology to the Department of Energy in 1981 for possible future use as an answer to dwindling fossil fuel resources and burgeoning urban trash disposal problems. In the years since the transfer, major oil companies and corporations on the forefront of environmental engineering have evidenced a growing interest in this Natick-developed technology " (NRDEC 1994:12).

1980s Development

During the early 1980s, the Natick Laboratories contained seven major functional elements consisting of three Directorates and four primary laboratories. These included: the Directorate for Systems Analysis and Concept Development (DSACD); the Directorate for Plans and Evaluation (DPE); the Directorate for Engineering Programs Management (DEPM); the Aero-Mechanical Engineering Laboratory (AMEL); the Food Engineering Laboratory (FEL) (developed army feeding systems including a liquid, electrolyte-nutrient system for soldiers encapsulated in protective suits in Nuclear, Biological and Chemical [NBC] environments); the Individual Protection Laboratory (IPL) (formerly the Clothing, Equipment, and Materials Engineering Laboratory (CEMEL); and the Science and Advanced Technology Laboratory (SATL), which was newly chartered in 1980 and explores "new research applications in feeding systems, nuclear weapons effects and hardening, abatement of military-caused pollution, and preventing microbiological material deterioration" [Nadick Laboratories 1981:17] (Butler 1984:70). In addition, the DoD Food Research, Development, Testing, and Engineering (RTDE) Program was located at Natick Laboratories (Natick Laboratories 1981, 1982]

By 1986, the primary mission of the Natick Research and Development Center (NRDC) was "the maximum survivability, sustainability, and supportability of the individual soldier in all environments through research, development and engineering in the area of food, clothing, shelters, airdrop and individual and organizational equipment" (NRDEC 1986:4). NRDC "operated a fully integrated laboratory complex that permitted research, development, testing, and engineering in food and food service, shelters, clothing systems, airdrop systems, and field service equipment" (Butler 1984:70).

1990s and Current Development

In October 1992, the Natick RD&E Center was designated a support element of the Army Aviation and Technology Command (ATCOM), St. Louis (NRDEC 1994:iii; AVSCOM Historical Division 1984:2, 87-91). In November 1994, the U.S. Army Soldier Systems Command was activated at Natick, and Natick RD&E Center became a line organization of it. In October 1998, the Soldier System Command merged with the Chemical Biological Defense Command to form the Soldier and Biological Chemical Command (SBCCOM), with Natick becoming the Soldier Systems Center (USASSC 1998).

Currently, "Natick carries out research, development, testing and engineering in food and food service systems, shelters, clothing systems, airdrop systems and field service equipment to sustain and support the combat soldier. Activities are housed in four prime Directorates: Aero-Mechanical Engineering, Food Engineering.

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Protection, and Science and Advanced Technology. Responsibilities also include the development of specifications and standards for products and commodities with military applications" (Fitch 1991:4).

Recognized for the unique research and development programs initiated by the Quartermaster Corps, SSC Natick continues to lead in the research, development, and testing of equipment for the current and future needs of the soldier. As such, Panamerican Consultants, Inc. (PCI) recommends the establishment of the Quartermaster Research and Development Center Historic District. Historically significant for its work during the Cold War-era, the installation continues today to push the boundaries of new technology and materials for the improvement and benefit of today's combat soldier.

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